Global Impact of International Standard ISO 9712

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Abstract. Since the introduction of ISO 9712 in May of 1992 several countries have adopted ISO 9712 as the foundation of their national and regional standards and NDT personnel certification schemes. ISO 9712 is a 'living' standard and continues to evolve, having been revised two times; the second edition was published in May of 1999 (ISO 9712:1999) and the third edition in March of 2005 (ISO 9712:2005). ISO 9712 benefits from the input of technical experts from many diverse countries and grows stronger by surviving the multi-dimensional challenges of international politics. ISO 9712 is a normative reference in two other ISO NDT personnel certification standards; ISO 20807 for limited applications and ISO 11484 for steel products. The value of ISO 9712, a third-party certification standard, is confirmed by it's inclusion within employer's qualification systems such as ISO 11484. Each edition of ISO 9712 has been followed shortly after by a revision of the regional European Standard EN 473, the European standard incorporating many of the provisions of the latest edition of ISO 9712. This purpose of this paper is threefold: Firstly, to provide a historical overview of the development of ISO 9712. Secondly, to highlight the positive influence of ISO 9712 on the certification schemes currently in place in countries round the globe. Thirdly, to explore where ISO 9712 may go in the future - the actions that might be performed to expand harmonization, the improvements that might be made to provisions within the existing Standard, the auxiliary documents and supporting organizations and activities will be needed to assist developed and developing countries and regions to implement ISO 9712.

1. Introduction

"International harmonization would ensure uniform levels of competence and standard of testing throughout all the countries. The first step in the international harmonization is the identification of the common international standard on which the national standards can be based. Towards this end, the International Committee on NDT (ICNDT) has played a leading role towards acceptance of International Standards Organization document ISO 9712 as the basis for harmonization" - *Baldev Raj*.

1.1 ISO Process

ISO 9712 is the under pinning foundation of employer-independent NDT personnel certification schemes of an estimated 40+ countries through out the world. This success is due in a large part to the Directives of International Standards Organizations that permit the participation of all national bodies (one per country) in formulating an ISO standard. In ISO, each national body has one vote so the needs of all countries are weighted equally. ISO 9712 was created in 1992 and was revised in 1999 and 2005 by a working group comprised of knowledgeable technical experts – this assured that technical arguments rather than political agendas controlled what went into the heart of the standard.

While the ISO 9712 standard is crafted by technical experts of the working group, the industrial and political preferences of countries come into play at the subcommittee level where national bodies have several opportunities to comment and vote on the acceptability of the standard at various stages – including committee draft (CD), enquiry draft (DIS), and final draft (FDIS). Observers cannot vote but may participate in the

discussions and can submit written comments - that must be considered. In between the votes, there is sufficient time for discussion, negotiation and resolution of disagreements. Thus, the ISO process operates on the principle of consensus and every attempt is made to resolve negative votes. An ISO Standard is approved only if a two-thirds majority of the votes cast by the participating members are in favour and not more that one-quarter of the total votes cast are negative. Note that all national bodies, whether participating members, observer members or not members at all have the right to vote on enquiry drafts (DIS) and final drafts (FDIS).

The ISO process is eminently fair – in sharp contrast to other standards organizations where membership may be restricted to regional groups, votes are weighted and observers don't have to be heard or their written comments considered.

This is the strength of ISO and the assurance that an ISO Standard like ISO 9712 truly represents the best technical/industrial/political input of the global community – and that everybody had their fair say. This is why ISO 9712 is so well accepted in the world today; why so many society, regional and national standards are based upon ISO 9712.

2. History of Development of ISO 9712

ISO 9712 was first published in May of 1992 as ISO 9712:1992 and quickly adopted by several countries as the basis for revision of their national standards including a regional modification/adoption in Europe as EN 473:1993. ISO 9712 is a 'living' standard and continues to evolve, having been revised two times. The second edition was published in May of 1999 (ISO 9712:1999) and more countries adopted it as the basis for revision of their national standards including a second regional modification/adoption in Europe as EN 473:2000.

The third edition was published in March of 2005 (ISO 9712:2005) and more countries continue to adopt it as the basis for revision of their national standards.

2.1 European Divergence from ISO 9712

The first issue of ISO 9712:1992 was followed a year later by issue of EN 473:1993 that included several perceived improvements over ISO 9712. The second issue of ISO 9712:1999 was followed a year later by issue of EN 473:2000 that included several enhancements and perceived improvements over ISO 9712.

Interestingly, ISO 9712:2005 was not seriously considered for regional modification/adoption in Europe as a new EN 473 for 2007/08. While many members of CEN/TC 138 directly participated in the five-year development of ISO 9712:2005, CEN/TC 138 made little effort to adopt ISO 9712:2005 or to even use it as the basis for revision of the new EN 473. On the contrary, several unusual actions were taken to curtail adopting the ISO standard as a European regional standard. CEN/TC 138 chose instead to revise the older EN 473:2000; as a result there will be significant differences between ISO 9712:2005 and the coming EN 473:2007/08. These differences may well impact acceptance of ISO 9712 certified inspectors and their inspected goods within the European Union and acceptance of EN 473 certified inspectors and their inspected goods outside of Europe.

2.1.1 World Trade Organization

In choosing not to adopt and/or modify ISO 9712:2005 and instead revise the older EN473:2000, CEN/TC 138 may have transgressed several provisions of the World Trade Organization (WTO) document, GENERAL AGREEMENT ON TARIFFS AND TRADE

21 June 1994, specifically Annex 3 – Code of Good Practice for the Preparation, Adoption and Application of Standards.

- E. The standardizing body shall ensure that standards are not prepared, adopted or applied with a view to, or with the effect of, creating unnecessary obstacles to international trade.
- F. Where international standards exist or their completion is imminent, the standardizing body shall use them, or the relevant parts of them, as a basis for the standards it develops, except where such international standards or relevant parts would be ineffective or inappropriate, for instance, because of an insufficient level of protection or fundamental climatic or geographical factors or fundamental technological problems.
- H. The standardizing body within the territory of a Member shall make every effort to avoid duplication of, or overlap with, the work of other standardizing bodies in the national territory or with the work of relevant international or regional standardizing bodies. They shall also make every effort to achieve a national consensus on the standards they develop. Likewise the regional standardizing body shall make every effort to avoid duplication of, or overlap with, the work of relevant international standardizing bodies.

2.1.2 World Reaction

Letters have been written by the International Committee for Nondestructive Testing (ICNDT), the European Federation for Nondestructive Testing (EFNDT) and the Asia-Pacific Committee for Nondestructive Testing (APNDT) to the heads of ISO/TC 135 and CEN/TC 138 indicating the importance of world harmonisation of non-destructive testing. How will this ISO/EN divergence play out? We will just have to wait and see.

3. Positive influence of ISO 9712

ISO 9712 has acted as a catalyst to promote the harmonisation of NDT certification programs throughout the world. Ideally, we would like have one unified international standard – ISO 9712. To quote Douglas Marshall, ICNDT President, "It makes sense for everyone throughout the world to be working to the same standard". Table 1 shows countries having national/regional standards that are modifications/adoptions of ISO 9712.

Table 1. Countries whose standards are modifications/adoptions of ISO 9712

Argentina	China	India	Norway	Sweden
Australia	Croatia	Ireland	Pakistan	Switzerland
Austria	Czech rep.	Israel	Poland	USA
Bangladesh	Denmark	Italy	Romania	Ukraine
Belarus	Finland	Japan	Russia	United Kingdom
Belgium	France	Korea	Serbia	Vietnam
Brazil	Germany	Mexico	Slovakia	
Bulgaria	Greece	Netherlands	Slovenia	
Canada	Hungary	New Zealand	Spain	

ISO 9712 is a normative reference in ISO 20807:2004, "2004 Non-destructive testing — Qualification of personnel for limited applications of non-destructive testing". ISO 9712 is also a normative reference in ISO 11484:1994 "Steel tubes for pressure purposes -- Qualification and certification of non-destructive testing (NDT) personnel" and in the coming revision that has expanded to cover all steel products, "Steel products — Employer's qualification system of NDT personnel". The value of ISO 9712, a third-party certification standard, is confirmed by it's inclusion within employer's qualification systems such as ISO 11484.

4. ISO 9712 – Future Harmonization

Where may ISO 9712 go in the future? What actions might be performed to expand harmonization?

4.1 Expansion

In my opinion, adoption of ISO 9712 will continue to expand, driven by the clear economic advantages of global harmonization. The only action required is vigilance to keep ISO 9712 relevant to the changing needs of NDT personnel certification. There no going back to 'yester-year' and the plethora of different certification standards.

Developing countries are actively seeking means to comply with ISO 9712. An example of this direction was clearly evident at the Asia-Pacific NDT Conference in Auckland New Zealand in November 2006. Under the guidance of Isaac Einav, the International Atomic Energy Agency (IAEA) actively promoted adoption of ISO 9712:2005 with IAEA Asia-Pacific member states of the Regional Cooperative Agreement for Research Development and Training Related to Nuclear Science and Technology.

Developed countries with long-standing non-ISO based certification programs are now moving to introduce ISO 9712 compatible standards. In the USA, ANSI/ASNT CP-106-2007 is new proposed American National Standard currently under development that is a modified adoption of International Standard ISO 9712.

New players continue to come forward to take active roles as ISO Secretariats in the development of new NDT standards. Examples are Korea for ISO TC135 SC8 - infrared thermography, Germany for ISO TC135 SC3 –ultrasonic and Brazil for ISO TC135/SC9 acoustic emission.

5. ISO 9712 – Future Improvements

What improvements might be made to provisions within the existing Standard?

5.1 Experience – before or after examination

In ISO 9712:1992, both training and experience were required before the qualification examination. The advantage of this was that candidates for examination were quite knowledgeable, usually having acquired experience and on-the-job training first then taken their formal training as a final 'polish' to prepare them for the examination. Training classes were generally filled with knowledgeable students. The disadvantage was that potential candidates, without NDT employment, could not gain the experience necessary to

challenge the examination – and few employers wanted to hire persons without experience. This cycle meant that person interested in certification but not working in NDT could not gain certification.

With the introduction of ISO 9712:1999, the situation changed – experience could be acquired either before or after success in the examination. The advantage was that a candidate could take training and challenge the examination; if he passed the certifying body could issue an attestation that the candidate needed only acquire the experience to be automatically certified. Such candidates were more attractive to potential employers, since with further experience, certification was assured. The disadvantage was that the quality of students seeking training began to decrease.

ISO 9712:2005 still allows experience to be acquired either before or after success in the examination. However, in these economic boom times, we are seeing a major increase in demand for certified personnel while at the same time many of the certified 'baby-boomers' are retiring. In North America, there is a critical shortage of certified NDT personnel and salaries continue to rise rapidly. High demand and high salaries are attracting many more persons to the NDT field than a few years ago. Training organizations are now flooded with persons with little knowledge of NDT seeking the fast road to earning 'Big Bucks'. Many of these persons haven't any knowledge of the NDT methods and simply sign up for courses, "I'm here for NDT!" The job of the training instructor has become difficult in the extreme; it may take most the course hours just to teach the theory, at the expense of the practical aspects of the method. What is the proper balance between theory and hands-on practical in an NDT method course? 50/50, 70/30? It is not specified in the standard; should it be?

Every candidate, and their employer, wants only enough training to meet the minima in the standard. Competition between training organizations makes longer courses impossible. Poorly prepared, with little or no experience, such candidates challenge the examinations and failure rates are notably up.

What's the solution? If we go back to requiring experience before examination, we may significantly reduce the supply of candidates seeking to enter the NDT field – and we do need new people. What if we require say 50% of the experience before examination? Some say the effect will be almost the same as requiring 100% - a major reduction in candidates. What if we significantly increase the number of hours of training required? This approach caters to the lowest quality of person seeking certification, and how much more training will such persons require? Is this not lowering the bar of excellence? This approach would severely penalize high-quality candidates - anyone who is working in NDT, gaining experience and learning on the job. Such knowledgeable individuals will have to spend an inordinately long time in a class full of "I'm here for NDT!" Is there a way that we can address this issue within the Standard?

5.2 Restriction on Discretion of the Certifying Body

Some feel that ISO 9712:2005 allows the certifying body too much discretion, particularly in assessing experience for:

- Quality (Some consider this a most difficult assessment to perform.)
- Simultaneous experience (With 10 unrelated NDT methods, why should there be reductions for experience in multiple methods? E.g. How does experience in radiography relate to experience in acoustic emission?)
- Level and quality of education (Education may be training but it is not industrial experience. Is there any proven industrial-world relationship between education and experience?)

5.3 Recertification

In ISO 9712, recertification by practical examination is based upon the premise that every 10 years a practical examination is necessary to determine the continued competency on certified NDT inspectors - and no alternatives are allowed. However, certification by practical examination for every certified person is very disruptive to business and quite expensive - requiring time off the job, travel, accommodation, examinations, etc. So, is that premise correct? Where is the proof? When ISO 9712 was first introduced in 1992, a practical examination seemed the only certain way of assuring continued competence – but we had no real definitive data on which to base that decision; it just seemed right. However, with the passage of more than ten years, several certifying bodies have accumulated statistical data on the failure rates of candidates challenging the recertification practical examinations.

5.3.1 Failure Rates on Recertification Examinations

- Australia = 6% based upon 100 re-certifications, Ave pass grade = 88%
- "Our NZ guys re-certifying in the non-NDT disciplines do a "written" exam which includes datasets, and the failure rate is significantly higher – around 25 – 30%. However I am not sure that this type of exam is relevant to the hands-on inspection these guys do every day and so it is possible that this puts them at a disadvantage in that a non-relevant exam can fail a perfectly competent inspector and so affect his livelihood – Peter Sheedy, AINDT.
- Brazil = 4% based upon 2580 re-certifications - João Conte, ABENDE.
- Germany = 0.4% based upon 1,310 exams
  'All applicants must take 3-day/method refresher training before examination. Persons with significant interruptions cannot do recertification exams but must start over at initial exams.' – Uli Kaps, DGZfP
- United Kingdom = ~22% (no details provided) – John Thompson, BINDT
- France = ~10% estimate based upon ~5,000 recertification exams – Michel Poudrai, COFREND
- Japan = 30% based upon 44,124 written recertification exams – Dr. Hatano, JSNDI
  "The Japan stats are parallel to our experience over the past 2 years with "Written" 10-year re-certification exams in the Non-NDT sector – failure rates of 20 to 30%. I think this says something about the relevance of written re-cert exams, and nothing about the on-the-job competence of the candidate." – Peter Sheedy, AINDT
- Canada = 1.6% based upon 249 exams (92 persons), or
  = 0% if 4 persons with significant interruptions are removed – Rick Murphy

5.3.2 Lessons Learned

From the above international statistics on examination failures one could say:

- Recertification-by-exam is a 'must' for persons with significant interruptions.
- Do not use written exams/datasets to assess practical competence.
- Refresher training is a viable alternative to recertification examination.

Every country is applying the intent of the ISO 9712 Standard, but each has sufficient flexibility within the provisions of the Standard to make their exams as easy or as difficult as the certifying body decides. This affects failure rates. Until every certification body applies the same examinations universally, the ISO 9712 requirement for a practical examination as the sole measure for determining the continued competence of the certified inspector is questionable. There may be simpler, equally effective and less costly ways to

meet the ISO 9712 recertification objective of proof of continued competence. Perhaps this should be considered and allowed for within the provisions of the Standard.

5.3.3 Alternative Approaches

Canada formed a Task Force to look into alternative means for recertification. One option that is being considered is the use of 'Task Qualification' as a form of impartial, practical examination. Task qualifications are used by several industries (particularly nuclear) to demonstrate proof of inspector competence for specific inspection tasks. These are typically blind tests, where the inspector has no prior knowledge of the specimen and flaws it may contain. Such task qualification tests are usually performed by employees of a company in the presence of external auditors. One possibility is for the certifying body to accept such independently audited task-qualification tests as assurance "that there is impartial evaluation to confirm the continuing competence of the certified person" as required by clause 6.5.2 of ISO/IEC 17024:2003.

Another option that will be investigated by the Task Force is the use of a special logbook that would be reviewed by the certifying body at each renewal (in Canada, every 3 years).

- One section of the logbook is designed to provide proof of "no significant interruption" and partial proof under ISO/IEC 17024:2003 to "ensure that the certified person continues to comply with the current certification requirements". e.g. demonstration of continuing to use all techniques that were used to obtain initial certification.
- A second section of the logbook is designed to provide proof under ISO 9712:2005 and ISO/IEC 17024:2003 to "ensure that the certified person continues to comply with the current certification requirements" - the key requirements being demonstrations of the abilities of the candidate in respect of Level 1 and 2 examination grading criteria per Annex D of ISO 9712:2005:
  1 - Knowledge of NDT apparatus
  2 - Application of NDT method
  3 - Detection of discontinuities and reporting
  4 - Writing of NDT instruction

  The most important item (3) being proof of the ability of the candidate to detect and assess indications in a component against a specified code/standard and to reports his results - as in a conventional practical examination. In each case, logbook entries would be confirmed by an impartial party (a person not working for the same employer as the inspector).

Hence it may only be necessary for those suffering a significant interruption to undertake recertification by practical examination.

6. Auxiliary Support

What auxiliary documents and supporting organizations and activities will be needed to assist developed and developing countries and regions to implement ISO 9712?

6.1 Specimen Standardization

ISO TC135/SC7 Working Group 8 is finalizing a standard that describes what specimens are acceptable for use in practical examinations. This should assist in harmonization of the level of difficulty of practical examinations.

6.2 Performance Demonstration

ISO TC135/SC7 Working Group 7 is working on a standard that describes what constitutes an adequate demonstration of performance – leading to certification. This should assist in harmonization in the number and level of difficulty of specimens used in the practical examinations.

6.3 International Atomic Energy Agency (IAEA)

IAEA actively promotes the adoption and use of ISO 9712 in member states. IAEA has been instrumental in producing guidance documents for developing countries that show how to form a national NDT society, how to develop a certification body and how to become accredited.

6.4 International Committee for Nondestructive Testing

ICNDT actively promotes harmonization of certification by encouraging the adoption and use of ISO 9712 throughout the world. Firstly ICNDT is seeking legal status. Once established as a legal entity, ICNDT will looking into establishing a common global bank of examination questions and becoming a global accreditation body for NDT certifying bodies.

7. Conclusion

ISO 9712 continues to thrive as a 'living document' with impartial, fair and balanced input by all interested parties. ISO 9712 continues to spread throughout the world and underpins many national and regional standards. ISO 9712 will continue to evolve to better suit the needs of industry and regulators.